

Claims

- [c1] 1. A radio communication device comprising:
 - a. a first radio integrated circuit (IC) that performs one or both of radio transmission or radio reception;
 - b. a second radio IC that performs one or both of radio transmission or radio reception; and
 - c. wherein the first radio IC generates and uses a local oscillator signal for radio transmission and/or radio reception operation, and wherein the local oscillator signal is coupled to the second radio IC for use in its radio transmission and/or radio reception operation.
- [c2] 2. The radio communication device of claim 1, wherein the local oscillator signal generated by the first radio IC is a radio frequency (RF) local oscillator signal.
- [c3] 3. The radio communication device of claim 2, wherein the second radio IC comprises a transmitter and/or receiver that receives and uses the RF local oscillator signal from the first radio IC for transmission and/or reception at a frequency corresponding to the frequency of the RF local oscillator signal.
- [c4] 4. The radio communication device of claim 3, wherein

the first and second radio ICs each use the RF local oscillator signal for simultaneously transmitting signals at the same radio frequency corresponding to the frequency of the RF local oscillator signal or for simultaneously receiving signals at the same radio frequency corresponding to the frequency of the RF local oscillator signal.

[c5] 5. The radio communication device of claim 4, wherein the first and second radio ICs each comprises a plurality of transmitters, and wherein the first radio IC supplies the RF local oscillator signal to each of its plurality of transmitters and the second radio IC supplies the RF local oscillator signal coupled from the first radio IC to each of its plurality of transmitters so that the plurality of transmitters of the first radio IC and the plurality of transmitters of the second radio IC simultaneously transmit a combined plurality of signals at a radio frequency corresponding to the frequency of the RF local oscillator signal.

[c6] 6. The radio communication device of claim 4, wherein the first and second radio ICs each comprises a plurality of receivers, and wherein the first radio IC supplies the RF local oscillator signal to each of its plurality of receivers and the second radio IC supplies the RF local oscillator coupled from the first radio IC to each of its plurality of receivers so that the plurality of receivers of the

first radio IC and the plurality of receivers of the second radio IC simultaneously receive a combined plurality of signals at a radio frequency corresponding to the frequency of the RF local oscillator signal.

[c7] 7. The radio communication device of claim 1, wherein the first and second radio ICs each comprises a port circuit, the port circuit in the first radio IC couples the local oscillator signal to the port circuit of the second radio IC, and the port circuit in the second radio IC couples the local oscillator signal from the first radio IC for use by its radio transmitter or radio receiver.

[c8] 8. The radio communication device of claim 7, wherein the port circuit in each radio IC is bi-directional and either (1) couples the local oscillator signal to the port circuit in the other radio IC or (2) couples the local oscillator signal generated by the other radio IC for use by its radio transmitter or radio receiver.

[c9] 9. The radio communication device of claim 8, wherein each radio IC comprises a package pin electrically connected to the port circuit, and further comprising an electrical connection between the package pin of the first and the package pin of the second radio IC.

[c10] 10. The radio communication device of claim 9, wherein

the package pin associated with the port circuit in each radio IC is used for coupling a local oscillator signal to or from the other radio IC.

- [c11] 11. The radio communication device of claim 1, and further comprising a baseband signal processor connected to the first and second radio ICs that generates a plurality of baseband transmit signals for simultaneous transmission by the first and second radio ICs and processes a plurality of baseband receive signals simultaneously received by the first and second radio ICs.
- [c12] 12. The radio communication device of claim 11, wherein the baseband signal processor supplies a first plurality of baseband transmit signals to the first radio IC and a second plurality of baseband transmit signals to the second IC such that the first and second plurality of baseband transmit signals are simultaneously transmitted by the first radio IC and the second radio IC, respectively, at a frequency corresponding to the frequency of the local oscillator signal, and wherein the baseband signal processor processes a first plurality of receive baseband signals from the first radio IC and a second plurality of receive baseband signals from the second IC, wherein the first plurality of receive baseband signals and the second plurality of receive baseband signals are simultaneously received by the first and second radio

ICs, respectively, at a frequency corresponding to the frequency of the local oscillator signal.

- [c13] 13. A radio device comprising:
- a. at least one of a radio transmitter to transmit a signal or a radio receiver to receive a signal;
 - b. a local oscillator signal source that provides a local oscillator signal that is coupled to the radio transmitter or radio receiver for use thereby; and
 - c. a port circuit coupled to the local oscillator signal source that either (1) couples the local oscillator signal to an external pin for connection to another radio device or (2) couples an externally generated local oscillator signal supplied at the external pin for use by the radio transmitter or radio receiver.
- [c14] 14. The radio device of claim 13, wherein the port circuit is bi-directional and comprises a first amplifier having an input that is connected to the local oscillator signal source and an output connected to the external pin, the first amplifier amplifies the local oscillator signal when it is to be coupled to another radio device, and a second amplifier having an input connected to the external pin and an output connected to the radio transmitter and radio receiver, the second amplifier amplifies the externally generated local oscillator signal when it is to be used, wherein the first amplifier is disabled when the

second amplifier is enabled and the second amplifier is disabled when the first amplifier is enabled.

- [c15] 15. The radio device of claim 13, and further comprising at least one frequency divider circuit that produces an intermediate frequency oscillator signal from the local oscillator signal.
- [c16] 16. The radio device of claim 15, and further comprising a phase lock loop system and wherein the at least one frequency divider circuit is connected inside the phase lock loop system.
- [c17] 17. The radio device of claim 16, wherein the local oscillator source provides a radio frequency local oscillator signal.
- [c18] 18. The radio device of claim 17, and further comprising first and second frequency divider circuits and a second port circuit connected to a node between the first and second frequency divider circuit that either (1) couples a signal that is twice the frequency of the intermediate frequency local oscillator signal to an external pin for connection to another integrated circuit radio device or (2) couples an externally generated signal supplied at the external pin to the node between the first and second divider circuits for use by the radio transmitter or radio

receiver.

[c19] 19. The radio device of claim 18, wherein the phase lock loop system comprises a phase detector, a voltage controlled oscillator and a multi-modulus divider, and wherein the multi-modulus divider has an input that is coupled to receive an intermediate frequency oscillator signal at an output of the second frequency divider circuit and an output that is coupled to an input of the phase detector, an output of the phase detector being coupled to the voltage controlled oscillator, and an output of the voltage controlled oscillator being coupled to an input of the first frequency divider circuit.

[c20] 20. The radio device of claim 15, and further comprising a phase lock loop system and wherein the at least one frequency divider circuit is connected outside the phase lock loop system.

[c21] 21. The radio device of claim 20, and further comprising a second port circuit coupled to the at least one frequency divider circuit that either (1) couples a divider reset signal to an external pin for connection another integrated circuit radio device or (2) couples an externally generated divider reset signal supplied at the external pin to the at least one frequency divider circuit.

[c22] 22. The radio device of claim 13, wherein the radio transmitter and/or radio receiver, local oscillator signal source and port circuit are implemented on a single integrated circuit.

[c23] 23. A radio device comprising:

- a. at least one of a radio transmitter to transmit a signal or a radio receiver to receive a signal;
- b. a local oscillator signal source that provides a local oscillator signal that is coupled to the radio transmitter or radio receiver for use thereby; and
- c. a port circuit coupled to the local oscillator signal source that couples the local oscillator signal to an external pin for connection to another radio device.

[c24] 24. A radio device comprising:

- a. at least one of a radio transmitter to transmit a signal or a radio receiver to receive a signal;
- b. a local oscillator signal source that provides a local oscillator signal that is coupled to the radio transmitter or radio receiver for use thereby; and
- c. a port circuit that couples an externally generated local oscillator signal supplied at the external pin for use by the radio transmitter or radio receiver.

[c25] 25. A port circuit comprising:

- a. a first terminal and a second terminal, the first termi-

nal for connection to a signal source and the second terminal for connection to an external pin of a radio integrated circuit;

b. a first amplifier connected between the first terminal and the second terminal to amplify a signal supplied at the first terminal for output to the second terminal;

c. a second amplifier connected between the first terminal and the second terminal to amplify a signal supplied at the external pin; and

d. wherein the first amplifier is disabled when the second amplifier is enabled and the second amplifier is disabled when the first amplifier is enabled.

- [c26] 26. A method for achieving phase and frequency coherency between first and second radio integrated circuits (ICs), comprising steps of:
- a. in the first radio IC, generating a local oscillator signal for use by at least one receiver or at least one transmitter in the first radio IC;
 - b. electrically coupling the local oscillator signal from the first radio IC to the second radio IC;
 - c. in the second radio IC, coupling the local oscillator signal to at least one receiver or at least one transmitter for operation, thereby ensuring that the at least one receiver in the first radio IC and the at least one receiver in the second radio IC will simultaneously operate with

phase and frequency coherency from the local oscillator signal, and the at least one transmitter in the first radio IC and the at least one transmitter in the second radio IC will simultaneously operate with phase and frequency coherency from the local oscillator signal.